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**PATENT APPLICATION OF**  
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**INK-RECEPTIVE CARD SUBSTRATE**

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## INK-RECEPTIVE CARD SUBSTRATE

The present application claims the benefit of U.S. provisional patent application Serial No. 60/439,647, filed January 13, 2003; and is a continuation-in-part of U.S. patent application entitled "PRINTER WITH REVERSE IMAGE SHEET," Serial No. 09/799,196 and filed March 5, 2001, the content of which is hereby incorporated by reference in its entirety.

### FIELD OF THE INVENTION

The present invention is related to card substrates, and more particularly, to a method and device for manufacturing card substrates having an ink-receptive coating.

### BACKGROUND OF THE INVENTION

Ink jet printers are known and provide a number of advantages in the printing process. For example, ink jet printers are capable of providing relatively high density color output at an acceptable printing speed. Furthermore, such printers are relatively inexpensive. As a result, it is desirable to utilize such printers in the formation of identification cards. Unfortunately, ink from ink jet printers does not adhere well to the plastic surfaces of most identification card substrates, which are typically formed of PVC. Accordingly, it is necessary to create an ink-receptive surface on the identification card substrate to allow it to receive an image printed by an ink-jet printer.

Methods have been used to provide ink jet printable or receptive surfaces on various types of substrates, such as compact discs and identification cards. In general, these methods involve coating the surface with an ink-receptive material. Once coated with the ink-receptive material, the card substrates can be used in identification card printers utilizing ink jet printheads, such as the CardJet 410 printer and encoder manufactured by Fargo Electronics, Inc. of Eden Prairie, Minnesota. Examples of such ink-receptive materials encoding methods are provided in U.S. Patent Nos. 6,051,306 and 6,270,858, which issued April 18, 2000 and August 7, 2001, respectively, and are both assigned to Fargo Electronics, Inc.

Ink-receptive films have also been applied to card substrates to form an ink-receptive surface thereon. As illustrated in FIG. 1, such ink-receptive films 10 are formed of a clear or an opaque backing layer (e.g., PET, PVC, etc.) 12, on which an ink-receptive coating 14 is applied. A layer of adhesive 16 is generally applied between the backing layer 12 and a surface 18 of a rigid or semi-rigid card member 20. Card member 20 is a conventional blank card substrate that is typically formed of PVC or other suitable material. A protective cover (not shown) is laid over the ink-receptive coating 14 and the backing layer 12 of the ink-receptive film 10 is laminated to card member 20 through application of

heat and pressure. Portions of ink-receptive film 10 that overhang the edges of card member 20 are then trimmed as necessary. A laminate layer 22 can be laminated to a bottom surface 24 of card member 20 by  
5 adhesive layer 26 in an effort to counterbalance stresses that are applied to card member 20 as a result of the lamination of backing layer 12 of ink-receptive film 10 to surface 18 of card member 20.

Unfortunately, the above-described process  
10 of forming an ink-receptive card substrate using an ink-receptive film is problematic. The layers of adhesive, ink-receptive film, card member, and the laminate, result in a complex and expensive ink-receptive card substrate. Also, the backing layer of  
15 the ink-receptive film can potentially delaminate from the card member due to its exposed edges, thereby limiting the useful life span of the ink-receptive card substrate. Additionally, the image that is printed to the ink-receptive surface that is  
20 formed by the ink-receptive coating of the film can be easily modified by replacing the printed ink-receptive film with another. As a result, these ink-receptive card substrates are complicated, expensive to form, have a limited life span, and offer little  
25 security against alteration.

Images that are printed to ink-receptive surfaces of card substrates that are formed in accordance with the methods described above are susceptible to defacement due to abrasion, exposure

to water, and other environmental conditions. Accordingly, a protective overlamine material must be applied over the printed ink-receptive surface to protect the printed image.

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#### SUMMARY OF THE INVENTION

The present invention is generally directed to a method of forming an ink-receptive card substrate. In the method, an ink-receptive material is provided. The ink-receptive material includes a backing layer and an ink-receptive coating on a surface of the backing layer. Next, a card member is provided. Finally, the ink-receptive material is laminated to a surface of the card member with the ink-receptive coating facing the surface of the card member. This results in the bonding of the ink-receptive coating to the surface of the card member. Additional embodiments of the present invention are directed to devices that are configured to perform the above-identified method.

Other features and benefits that characterize embodiments of the present invention will be apparent upon reading the following detailed description and review of the associated drawings.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a simplified side cross-sectional view of an ink-receptive film that is applied to a

card substrate in accordance with methods of the prior art.

FIG. 2 is a flowchart illustrating a method of forming an ink-receptive card substrate in accordance with embodiments of the invention.

FIGS. 3-5 are simplified side cross-sectional views of various stages of a method of forming an ink-receptive card substrate in accordance with embodiments of the invention.

FIG. 6 is a simplified cross-sectional view of a card substrate that includes an embedded chip and an ink-receptive coating that has been applied in accordance with a method of the present invention.

FIG. 7 is a schematic diagram of a device that is configured to form an ink-receptive card substrate in accordance with embodiments of the invention.

FIGS. 8 and 9 are simplified side and top views of a separator in accordance with embodiments of the invention.

FIG. 10 is a simplified side view of a device that is configured to form an ink-receptive card substrate in accordance with embodiments of the invention.

FIG. 11 is a simplified top view of a separator in accordance with embodiments of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 2 is a flowchart illustrating a method of forming a card substrate having an ink-receptive surface, in accordance with embodiments of the invention. Various stages of the method are also  
5 illustrated in FIGS. 3-5.

In the method, an ink-receptive material 30 is provided, as indicated at step 31 of FIG. 2 and shown in FIG. 3. Ink-receptive material 30 includes an  
10 ink-receptive coating 32 on a backing layer 34 (e.g., PET). Suitable ink-receptive materials 30 are produced by Chromaline Corporation of Duluth, Minnesota, such as AccuArt™ and AccuBlack™, which are generally used for the production of film positives, negatives, color  
15 proofs and full-color presentation transparency displays.

At step 36 of the method, a card member 38 is provided. Card member 38, shown in the cross-sectional view of FIG. 3, is preferably formed of a  
20 rigid or semi-rigid material, such as PVC, which has a surface 40 that is generally unreceptive to ink. Card member 38 can be in the form of an individual card substrate (i.e., standard identification card size). Alternatively, card member 38 can be in the form of a  
25 sheet (e.g., 2 ft. by 2 ft.) of card substrate material, from which individual card substrates can be cut, to facilitate mass card substrate production.

Even though it is possible to perform the method of the present invention when ink-receptive

material 30 conforms to or is formed smaller than the card member 38, it is desirable to have the ink-receptive material be slightly larger than surface 40 of card member 38 to transform the entire surface 40 into an ink-receptive surface. Thus, it is desirable that ink-receptive material 30 overhang the edges of card member 38, as shown in FIG. 3. Ink-receptive material 30 can be in the form of an individual sheet, a web of individual sheets that are linked together, or an ink-receptive film or web that is carried by supply and take-up rolls, as will be discussed below in greater detail.

Ink-receptive material 30 is laid over card member 38 with the exposed ink-receptive coating 32 facing a surface 40 of card member 38, as shown in FIG. 3. Next, ink-receptive material 30 is laminated to card member 38 under application of heat (approximately 300°F) and pressure, as indicated at step 42 of the method. This causes ink-receptive coating 32 to bond directly to surface 40 of card member 38. Finally, at step 44, backing layer 34 of ink-receptive material 30 can be removed from ink-receptive coating 32, as shown in FIG. 4. During this step, ink-receptive coating 32 that was bonded to surface 40 of card member 38 during the laminating step 42, remains bonded to surface 40 to thereby form an ink-receptive card member 46 shown in FIG. 5. Surface 40 of card member 38 can be coated with a bonding material to promote adhesion of the ink-receptive coating 32 to surface 40, if necessary. A



portion 48 of ink-receptive coating 32 that was not bonded to surface 40 of card member 38 remains attached to backing layer 34, as shown in FIG. 4. As a result, the method of the present invention avoids having to  
5 trim backing layer 34.

Ink-receptive card member 46 is ready to receive an image on ink-receptive surface 40 to produce an identification card. Preferably, ink-receptive card member 46 is sized for use in an identification card  
10 printer that utilizes an ink jet printhead to print the image to surface 40. Accordingly, when card member 38 is a sheet of card substrate material, ink-receptive card member 46 must be cut into individual card substrates prior to use in an identification card  
15 printer. Such cutting of ink-receptive card member 46 can be conducted either prior to the removing step 46 or after. In order to provide protection to ink-receptive surface 40 during transport and handling of ink-receptive card member 46, the removing step 44  
20 should be delayed until just prior to the use of ink-receptive card member 46.

The method of the present invention can also form an ink-receptive coating on smart card substrates or card members 38 that include a micro-module or chip  
25 50 having a contact plate 52, shown in FIG. 6. When applying an ink-receptive coating to a surface 54 of the card member 38 through which contact plate 52 is exposed, it is desirable to avoid covering contact surface 54. Experiments have shown that the ink-

receptive coating 32 of ink-receptive material 30 adheres to surface 54 of card member 38 while desirably releasing from contact plate 52 of chip 50 when the backing layer 34 is removed, as shown in FIG. 6.

5 Accordingly, the method of the present invention is effective in applying the ink-receptive coating 32 to such smart card substrates. If the method of the prior art were used, a portion of backing layer 34 that covers the contact plate 52 would have to be removed.

10 In accordance with another embodiment of the present invention, an image is printed to surface 60 (FIG. 3) of ink-receptive coating 32 of material 30 prior to the laminating step 42 while ink-receptive coating 32 remains adhered to backing layer 34.

15 Preferably, the image is reverse-printed to allow for the proper viewing of alphanumeric symbols through the substantially transparent layer of ink-receptive coating 32 once it is laminated to surface 40 of card member 38. The layer of ink-receptive coating 32

20 operates to protect the printed image from the environment. Additionally, this embodiment of the invention also provides greater security from alteration. Backing layer 34 can remain attached to ink-receptive coating 32 following the laminating step

25 42 (removing step 46 not performed) to provide additional protection thereto. Accordingly, it may be necessary to trim portions of backing layer 34 that overhang edges of card member 38 and the ink-receptive coating attached thereto to complete the formation of

an identification card. Additionally, ink-receptive material 30 can include an adhesion promoter (e.g., a primer or an adhesive) between backing layer 34 and ink-receptive coating 32 to ensure that backing layer 5 34 remains attached to ink-receptive coating 32.

A device 70 that is configured to perform the various embodiments of the method of the present invention is schematically shown in FIG. 7. Controllers, electrical connections, sensors, and 10 other conventional components are not shown to simplify the discussion of the invention. Device 70 generally includes a supply 72 of ink-receptive material 30 and a laminating section 74. In accordance with one embodiment of the invention, 15 supply 72 contains a plurality of individual sheets 76 of ink-receptive material 30. A sheet feed mechanism 78 includes a plurality of feed and drive rollers 80 that are configured to transport individual sheets 76 from supply 72 to laminating 20 section 74. Device 70 can also include a card supply 82 that is configured to contain a plurality of card members 38. Individual card members 38 contained in card supply 82 can be fed therefrom to laminating section 74 by a card feed mechanism 84 that includes 25 a plurality of guide and feed rollers 86. Sheets 76 of ink-receptive material 30 are fed to laminating section 74 such that the ink-receptive coating 32 faces the surface 40 of card member 38 that is to be formed into an ink-receptive surface. Accordingly, in

the embodiment depicted in FIG. 7, device 70 feeds sheets 76 with ink-receptive coating 32 facing upward while card members 38 are fed with surface 40 facing downward. However, other configurations are possible.

5           Laminating section 74 receives a card 38 and a sheet 76 with the sheet 76 preferably covering the entire surface 40 of card member 38. Laminating section 74 includes a heated roller 88 and a backup roller 90. Card member 38 and the adjoining sheet 76  
10 are fed between heated roller 88 and backup roller 90. Heated roller 88 applies heat to sheet 76 while card member 38 and sheet 76 are pinched between heated roller 88 and backup roller 90 to laminate ink-receptive sheet 76 to surface 40 of card member  
15 38. This results in the bonding of ink-receptive coating 32 of ink-receptive sheet 76 to surface 40 of card member 38, as discussed above.

          Following the lamination of ink-receptive sheet 76 to card member 38, the laminated card member  
20 38 can be discharged and the backing layer 34 of ink-receptive sheet 76 can be removed at a later time. Alternatively, device 70 can include a separator 92 that is configured to remove backing layer 34 of ink-receptive sheet 76 as discussed above to complete the  
25 formation of an ink-receptive card substrate 46, as discussed above. The removed backing layers 34 with the portions of ink-receptive coating 32 that were not bonded to card member 38 can be collected in a sheet hopper 94 while the ink-receptive card

substrates 46 are discharged to card hopper 96 by card feed mechanism 84.

One embodiment of separator 92 includes one or more wedge members 98, as illustrated in the simplified side view of FIG. 8 and the simplified top view of FIG. 9. Wedge members 98 deflect backing layer 34 away from ink-receptive coating 32 and card member 38 as laminated card member 38 is fed in the direction indicated by arrow 100 (FIG. 9) to completely remove backing layer 34 from laminated card member 38 and complete the formation of ink-receptive card substrate 46. The removed backing layer 34 can then be collected in sheet hopper 94 and ink-receptive card substrate 46 can be collected in card hopper 96, which are shown in FIG. 7.

In accordance with another embodiment of the invention, the supply 72 of ink-receptive material 30 is in the form of an ink-receptive film 102 that is wound on a supply roll 104. The ink-receptive coating 32 is positioned below backing layer 34. Ink-receptive film 102 along with a card member 38 are fed to laminating section 74 using conventional drive and feed rollers 105 where they are received between heated roller 88 and backup roller 90. Heated roller 88 applies heat and pressure to ink-receptive film 102 and card member 38 in the manner discussed above to laminate ink-receptive film 102 to card member 38 such that the ink-receptive coating 32 bonds to surface 40 of card member 38.

Device 70 can also include a cooling station 106 through which card member 38 and the bonded ink-receptive film 102 is transported. Cooling station 106 can include heat sinks 108 and a fan (not shown) to accelerate cooling of the laminated card member 38.

Device 70 also preferably includes a separator 92 that is configured to peel backing layer 34 of ink-receptive film 102 away from the ink-receptive coating 32 that is bonded to surface 40 of card member 38 and collect backing layer 34 on a take-up roll 110. Separator 92 can include wedge members 98 as discussed above. Alternatively, separator 92 can include a peeling roller 112 that redirects backing layer 34 to take-up roll 110 at an acute angle relative to surface 40 of card member 38. In accordance with one embodiment of the invention, an axis of rotation 114 of peeling roller 112 is oriented at an acute angle 116 relative to a direction of travel of card member 38 that is indicated by arrow 118. This configuration reduces the force required to begin removal of backing layer 34 from card member 38 by initially peeling backing layer 34 at a corner 120 of card member 38.

In accordance with another embodiment of the invention, device 70 includes a printhead 122 that is configured to receive ink-receptive material 30 and print an image on the ink-receptive coating 32, as shown in FIG. 7. Printhead 122 is preferably

an ink jet printhead that is operated in accordance with conventional methods. As discussed above, printhead 122 preferably prints a reverse image to ink-receptive coating 32 of ink-receptive material 30 such that alphanumeric symbols are appropriately displayed when viewed through the layer of ink-receptive coating 32 that is bonded to surface 40 of card member 38.

In accordance with another embodiment of the invention, printhead 122 is positioned to print on the ink-receptive coating 32 that is bonded to surface 40 of card substrate 38. For the device 70 depicted in FIG. 7, this requires printhead 122 to generally be flipped in the vertical direction such that it prints upward onto the downwardly facing surface 40 of ink-receptive card member 46. Additionally, printhead 122 is preferably positioned downstream of separator 92.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.